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AUTHOR Evans, C. D.
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ABSTRACT

This paper describes the experiences of the industrial research laboratory of Kodak Ltd. in finding and providing a computer terminal most suited to its very varied requirements. These requirements include bibliographic and scientific data searching and access to a number of worldwide computing services for scientific computing work. The provision of a few additional facilities over and above the minimum required has improved the search capabilities and increased terminal utilization in the laboratory. The paper illustrates by examples the use of the equipment, control of the terminal, and the training of laboratory staff. It also includes a discussion on how and why the equipment installed was chosen. (Author/RAA)

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THE VERSATILE TERMINAL

by

C.D. Evans

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THE VERSATILE TERMINAL

C.D. Evans, Kodak Ltd, Research Division, U.K.

ABSTRACT: This paper describes the experiences of an industrial Research Laboratory of finding and providing a terminal most suited to its very varied requirements.

These requirements include Bibliographic and Scientific Data Searching and access to a number of worldwide bureaux computing services for scientific computing work. The provision of a few additional facilities over and above the minimum required for access to on line data bases has improved the search facilities and increased the utilization of the terminal in the Laboratory.

The paper is illustrated by examples of the way in which the equipment is being used, control of the terminal, and how the staff of the Laboratory was trained to use it. It also includes a discussion on how and why the equipment finally installed was chosen.

1 INTRODUCTION

The Research Laboratories of Kodak Limited are organized by Research Discipline together with several general services, such as a Department of Information Services and Scientific Data Services. These general service departments provide a service to the whole of the Research Laboratory. Apart from Photographic related research, the Laboratory provides some services to other areas in Kodak Limited.

The Scientific Data Services section works closely with other parts of the Research Laboratory, providing a computing and data communications service.

At the end of 1976 and early 1977, the possibility of installing some form of interactive terminal in the Laboratory was investigated. This investigation showed three possible uses for such a terminal i.e.:

- (a) Use of the Mass Spectral data base, at that time supplied by Cyphernetics who were later taken over by A.D.P.
- (b) Use on line bibliographic search services.
- (c) Use of interactive computing services.

It was decided to conduct a six month trial of the visibility of these services within the Laboratory. The terminal chosen for this trial was an IBM 2741. The choice was made for the following reasons.

- (i) The terminal could be rented on a monthly contract.
- (ii) The rental was cheap - i.e., £68 per month.
- (iii) There was experience of this terminal in Kodak Limited used as a terminal to the IBM 'CALL' interactive computing service.
- (iv) It was easy to obtain at fairly short notice.

Experience of use of this type of terminal in the company had shown that it was desirable to connect it to the outside world via a direct Post Office line (i.e., not one going via the site telephone switchboard), and a Post Office modem.

The telephone line, modem and terminal were ordered, and installed and tested by May 1977. For security reasons the telephone is kept in a lockable box, and the terminal and other equipment in a lockable room.

2 EXPERIENCES WITH THE TRIAL TERMINAL

The IBM 2741 terminal is a golfball type electric typewriter with a standard QWERTY keyboard. It transmits and receives information in EBCDIC code, a code used by most IBM mainframe computers. It types at a speed of 13.4 characters per second, with a printing width of 132 characters on standard 14.5 inch computer stationery. Character sets can be changed by changing the printing golfball. The golfball is a spherical ball with the print characters molded on its surface.

The first service the terminal was connected to was the IBM 'CALL' interactive computing service. This was closely followed by the SDC and Lockheed Bibliographic search services, and by the Cyphermatics Mass Spectral search services. Later, the CSS interactive computing service was added to provide an APL computing facility.

Use of the terminal for search services was restricted to a few trained people in the Laboratory. This was due to the cost of searching at an average of £1 per minute of on line time, and it was considered to be cheaper and more efficient to do it this way. The interactive computing services were made available to all members of the Laboratory who needed to use them.

A booking and recording system was introduced so members of the Laboratory could book the terminal in advance, and be assured that it would be available at that time. The recording system enabled the utilization of the terminal to be monitored, and spot checks to be made on the cost of the services used.

Use of the terminal grew during the trial period, with peaks during the learning time as each service was introduced. Both the bibliographic search services and interactive computing services soon proved their worth in the Laboratory. For various reasons the Mass Spectral search service did not, at that time, prove to be so useful. By the end of the trial period it was decided that the terminal was a proven valuable additional tool within the Laboratory. It had come to stay!

3 SPECIFICATION OF A NEW TERMINAL

The IBM 2741 terminal had provided a vehicle on which to, fairly cheaply, gain experience. However, it left much to be desired if the use of an interactive terminal was to meet the growing requirements for interactive services in the Laboratory. Its main disadvantages were:

- (a) It was very noisy
- (b) It was slow

(c) Because it used the EBCDIC code some services (e.g., DIALTEC) could not be accessed from it.

(d) It could not adequately fulfill a requirement for plotting graphs.

During the trial period members of the Laboratory had learnt what working with an interactive terminal was like, and it was now possible to specify an 'ideal' terminal for the Laboratory.

This specification was as follows:

The Terminal should:

- (i) receive and transmit data in ASCII code with the option of using EBCDIC code when required;
 - (ii) work with a Post Office modem;
 - (iii) be capable of either Full or Half Duplex operation;
 - (iv) have a speed of at least 30 characters per second;
 - (v) have interchangeable ASCII and APL character sets, plus the usual terminal function keys;
 - (vi) be able to plot a graph;
 - (vii) be reliable and easy to maintain;
 - (viii) be as quiet as possible;
 - (ix) be able to print a line of at least 132 characters on standard 14.5 or 15 inch wide computer paper;
 - (x) be able to handle punched paper tape;
 - (xi) have a high quality printing capability.
- In addition desirable characteristics of the terminal were:
- (xii) It should be possible to add a VDU if, and when, required;
 - (xiii) it should be possible to add a mass storage device such as a cartridge tape or floppy disc unit;
 - (xiv) it should have some limited intelligence.

The reasons for most of these requirements will be obvious to those of you who have worked with an interactive terminal. Items (vi) and (x) were specialised requirements for the needs of the Laboratory. This was because many laboratory instruments are capable of recording data on punched paper tape usually via a teletype. There is a requirement to feed this data into a computer, mathematically manipulate the data, then plot the result. Most of the other items are functions of ease and reliability of using the terminal, or of accessing a wide range of services.

Having defined the ideal terminal for our needs, the next stage is to find one.

It is possible to wade through the long list of terminals in the Computer Users Year Book (366 from 106 suppliers), tramp around exhibitions and attend conferences (which are never on when you want them most) in order to find your terminal. By far the best way is to talk your problem over with acquaintances in the same line of business in the hope of getting a more direct lead. Search service suppliers are a good start if you have no knowledgeable acquaintances.

I was lucky, I found someone who knew someone who was looking for a similar terminal to that which I wanted. A visit narrowed the suppliers down to three possibilities, all of whom could fulfill most of the items in my specification.

After that it was a question of detailed discussion with the appropriate salesmen and, most important, with other users of the equipment.

It was soon apparent that some of our requirements conflicted. For instance; the quietest printers were thermal printers, but they required special paper, and neither they or the matrix printers (which were the next in order of quietness) produced as clear a copy as impact printers. Impact printers are, because they use a hammer to print, noisy.

The eventual choice of supplier was Anderson Jacobson.

The choice of equipment was an AJ 832 printer with plotting, APL and EBCDIC options together with an AJ430 punched paper tape station.

The reasons for this choice were:

(A) The quipment complied with nearly all the items in the ideal specification. Its only apparent fault was that it was noisier than I had hoped for, although still a lot quieter than the IBM 2741.

(B) All users I spoke to spoke very highly of both the equipment and suppliers, particularly the maintenance and repair service offered by Anderson Jacobson.

(C) The Head Office of the suppliers was geographically close to the Research Laboratories.

(D) The cost (Printer and GPO Barrier Box £3,267.50 - Paper Tape Station, £1,450) was within my budget.

(E) The equipment was 'well sold' to me and to members of the Laboratory who would be expected to use it.

4. THE NEW TERMINAL

The new terminal was delivered during May 1978. It was tested, user instructions were written and it was installed next to the IBM 2741. The 2741 was transferred to operating via an acoustic coupler so the two terminals could be operated (one at a time) for an overlap period of about one month while users got used to the new terminal.

Once users were accustomed to using the new terminal, several additional services were added, the most important of which were the DIALTEC bibliographic search service and a plotting program. Later, the changeover from the Interactive Data Base Access Service to the International Packet Switch Data Service (IPSS) was made easier because of the new facilities.

New techniques were developed for both searches and interactive computing using the full range of facilities of the new equipment. The most important of these are as follows:

(a) Punched Paper Tape (PPT) input of data.

Punched paper tape obtained from instruments in the Laboratory, or containing manually prepared data could be utilized to pass data to a remote computer at 10 or 30 characters per second. Because the tape was prepared off line, data preparation could be done at leisure and checked without incurring computing or telephone charges.

(b) Preparation of Searches on Punched Paper Tape (PPT).

The basic search strategy can be prepared on punched paper tape and edited as required. This involves the use of stacked commands, and can be sent to the search service a line at a time using the EDIT button on the paper tape unit. This button allows tape to pass through the reader up to the next RETURN character, when it stops until the EDIT button is pressed again.

Many searches for the laboratory involve chemical names and synonyms which are difficult to key in accurately. Use of tape enables these words to be typed and checked off line.

Breaks in the sequence of stacked commands allow the searcher to interactively combine groups of commands according to the results obtained. All 'Print' commands other than 'Trial Print' are always keyed in interactively.

Use of tape also allows complex searches to be easily and accurately carried out on a number of related data bases. This technique is not a substitute for the 'store' commands, but rather complements them.

Tape data characters are transmitted at 30 characters per second, so for long and complex searches this can save a considerable amount of on line time.

(c) Login using Punched Paper Tape

When IPSS was first tried I was faced with the prospect of having to type in 40 characters within the time out period of 30 seconds. This has since been changed but at the time was a daunting prospect for a collection of two-finger typists.

The solution was to put the complete login sequence on punched paper tape. It was possible to insert in the tape sequence a few additional facilities such as a check on PAD parameters.

Separate tape sequences were required for each service using IPSS, but this was easy to provide. Every user of IPSS was provided with their own length of tape with the login sequences punched on it.

(d) Page Formatting

The Anderson Jacobson terminal is provided with a number of 'Escape' commands which can be used to format the on line output. These include margin settings, top of page position, and the ability to automatically skip several lines (usually 6) between pages. Properly used this helps presentation of both computer and on line search data. For instance, it avoids printing over page perforations and allows search pages to be stored in binders without 'loosing' information in the page fold.

(c) Parity check.

The Anderson Jacobson Terminal is provided with an automatic parity check which can be turned on or off by a switch. When the switch is set to 'OFF', the terminal will make a 'best guess' at any character it does not fully recognise, and print it. When the switch is set to 'ON' any character it does not fully recognise is replaced by

an asterisk and, at the same time, an alarm bleeps. Because the Punched Paper Tape Unit punches a bit pattern without trying to interpret the character received, it is possible to record characters received from the computer being accessed on tape, while the terminal is printing with the parity check switch off, then later print the contents of the tape in an off line mode with the parity check switch on. Comparison of the two printouts will show up any errors caused by line noise.

While it is possible to accept misprints in the English language, as there is sufficient built in redundancy in most textual passages to convey the meaning despite a few wrong characters, this becomes important in the case of numerical printout where, in most cases, no redundancy exists.

An additional advantage, having recorded the output on tape, is that it can be edited for purposes of presentation. While editing, erroneous characters can be corrected, and surplus information eliminated.

(f) Horizontal and Vertical Pitch control

On the Anderson Jacobson terminal both horizontal and vertical pitch can be varied over a wide range using 'Escape' commands. This has proved very useful in presentation of printed output, particularly some computed output and tables.

(g) Plotting

A variety of plotting techniques have been developed on the terminal. An example of a plot is shown in Fig 1. This plot uses the 'full stop' character, although any suitable character can be used. Resolution is about 1/50 inch.

The biggest problem with plotting is occasional noise transmitted which can distort the plot. To overcome this, most plots are recorded on punched paper tape. Noise can then be seen on the tape and physically edited out. The big advantage of punched paper tape is that you can see each character, and also reproduce the corrected plot off line.

The plotting facility has been used in searching; on the Cyphernetics/ADP Mass Spectral search service it was possible to plot spectra. At the time of writing it has not yet been tried on the Chemical Information Service (CIS).

The services currently available to Research Laboratory staff on the new terminal are;

Bibliographic search services:

S D C

DIALOG

DIALTEC

BLAISE

Computing Services:

IBM CALL

CSS

8

The Chemical Information Service is currently being installed on the terminal and an interactive computing service called VSPC will soon be available on the Company IBM computers. What has been the cost of these facilities? Costs updated to the present time (July 1979) are:

AJ. 832	Terminal Basic Cost	£2,560
plus	EBCDIC and Correspondence Codes	£100
	APL	£100
	Ultra plot	£100
AJ. 430	Paper Tape Unit	£1,450
	TOTAL:	£4,310

plus the cost of a direct line telephone and the rental of a Post Office modem.

Monthly maintenance costs now amount to £42 per month, plus the cost of paper and typewriter ribbons.

5 TRAINING AND CONTROL

Many of you may feel that the facilities already described are useful, indeed desirable, and yet be worried by the problem of how users could be trained to make use of these facilities.

At Kodak Limited, use was made of training offered by the suppliers of the various services, whenever this was available. This taught users the basic concepts of, for example, searching.

Training in the use of the terminal facilities was solved in two ways.

First, a basic set of instructions on how to use the equipment was written. These were written in laymen's language, carefully avoiding unexplained jargon. These instructions were given to all terminal users. Supplementary instructions were then prepared on how to use the equipment with specific reference to a particular service. These supplementary instructions covered login procedures, how to use passwords, how to preset the equipment for best results, special techniques, and how to log off. Supplementary instructions were prepared for each service, and for major facilities provided by the services such as plotting. The instructions did not cover such items as search commands or basic programming techniques. These items were left to the user to consult the suppliers' literature.

Secondly, about an hour's personal instruction was given to each potential terminal user by me or a member of my section. Thereafter, any user could consult someone if he or she got into any difficulty.

In addition, complete sets of manuals and most instructions are kept in the terminal room, as well as being available for loan (in some cases permanent loan) to all terminal users.

This seems to have worked, and users quickly learn how to use the equipment efficiently for their purposes. They all have a personal copy of the instructions both for the equipment, and the services they are entitled to access.

Both equipment and the services accessed are expensive, so some control has to be kept on their use. Control is exercised in the following way:

(a) The equipment is kept in a lockable room and, in addition, the direct telephone is kept in a lockable box. Keys to both room and telephone are kept in an area which is permanently manned during working hours (the Library Office).

(b) A register is kept of all those who are entitled to use the terminal, and which services they are entitled to use.

(c) Users book time on the terminal in advance in a diary kept in the Library Office and collect and return the keys according to the time they have booked.

(d) At the conclusion of their session on the terminal all users complete a form (Fig 2) and return this with the keys to the Library Office.

These forms are used to monitor terminal utilization (Fig 1) and to spot check bills received from the various services used.

(e) A fault log is kept of all faults and unexplained happenings which users experience. This covers faults or problems in both the equipment and the services accessed via the terminal. The fault log is checked daily, and appropriate action taken when necessary. This has proved to be invaluable, especially when correcting an intermittent fault.

(f) Security is controlled by:-

(i) All systems have passwords for access to the system. Only those entitled to use a system know the password for that system. Most passwords can be changed if necessary.

(ii) Only those who need to access a system have copies of the supplementary instructions for that system. Without these it is difficult to obtain access to a system.

(iii) All suppliers offer detailed usage records for their system, usually supplied with the monthly account. Spot checks are made to check that these records agree with information obtained from the terminal use forms.

6 TERMINAL UTILIZATION

Fig 1 is a plot of terminal utilization which was derived from information recorded on the Terminal Use Forms (Fig 2). Percentage utilization is defined as the number of hours in a month someone was using the terminal equipment, divided by the number of normally available hours in that month, and expressed as a percentage. In this way, weekends and bank holidays are allowed for. The plot is presented as search utilization, computing utilization and total utilization.

Peaks of around 60% are shown on the graph and, if the current trend continues, additional terminal facilities will be needed before long.

Some relief on the use of the equipment has recently been achieved by purchasing a second-hand teletype for about £450 as an off line punched tape preparation facility.

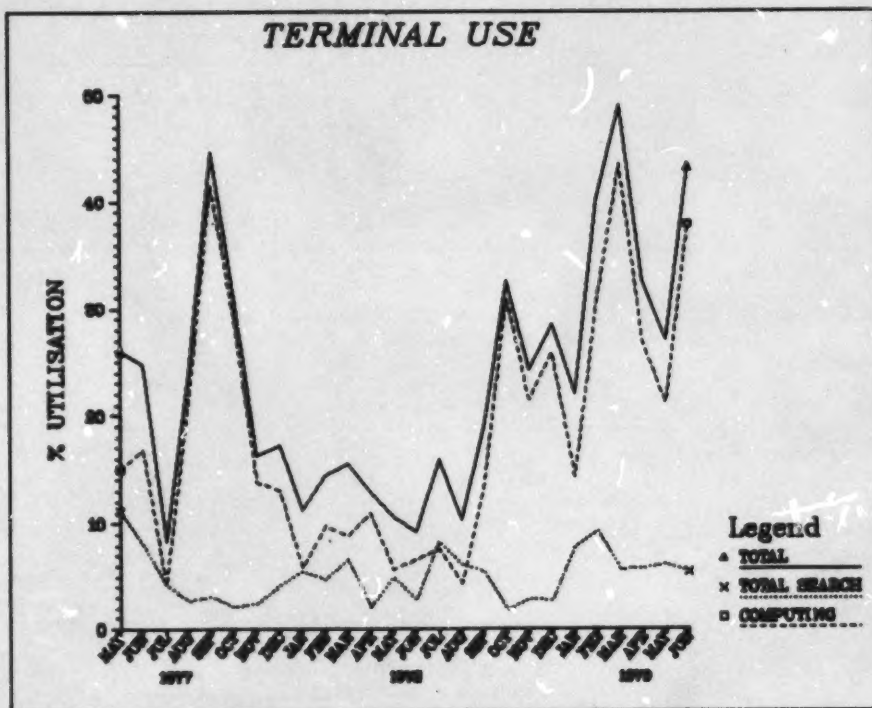


FIG 1 Plot Of Terminal Utilization

FORM NO. _____
 NAME _____ DEPT/LAB. _____ DATE _____
 START TIME _____ FINISH TIME _____

	1	2	3	4	5
SYSTEM(S) ACCESSED					
FILE(S)/DATA BASE(S)					
CPU/CPU UNITS					
ELAPSED/CONNECT TIME					
OFF LINE CITATIONS					
OTHER CHARGES/REMARKS					
FAULT MESSAGE NO					

COMMENTS:

PLEASE COMPLETE THIS FORM AND RETURN IT TO THE LIBRARY OFFICE WITH THE TERMINAL KEYS.

FIG 2 Terminal Use Form

Fig 1 was prepared and plotted on the terminal equipment described in this paper. The actual size of the line enclosing the plot is 13 x 10.5 inches. The character used to plot was the full stop.

7 MORE FACILITIES

So far this paper has described what has been achieved up to the time of writing (July 1979). However, this is not the end of the story. Technology continues to advance both in terms of equipment and services available. Requests come from scientists in the Research Laboratory, usually beginning 'Would it be possible to....', or 'It would be invaluable if we could only do....'. It is part of my job to satisfy these requests if it can be done economically. This section discusses additional facilities which it is planned to provide, or which I am keeping an eye on.

Two services are currently being added to those available now as indicated earlier in this paper, i.e.,

VSPC (personal computing services) on the Company

IBM computer; and

the Chemical Information System (CIS).

At present we have little or no experience of either of these services.

Additional equipment will soon be available or is being considered as follows:-

VDU

More buffer memory in the terminal

Floppy disc unit

120 characters per second facility

These are discussed below:-

(a) VDU

An Anderson Jacobson 510 VDU has been delivered and initial tests have been made with it. Instructions for use are currently being written.

What additional facilities will this VDU provide?

Why purchase this VDU out of the large number available.

A VDU enables the user to only print that part of an interactive terminal session which he or she requires, thus saving a considerable quantity of paper. This means that log in procedures and standard parts of searches need not be printed.

Many users prefer to use a VDU for both searching and interactive computer work because it is very much quieter in operation, and the text editing facilities available on the screen enable a user to more easily correct errors. It is possible, on this VDU, to compose a whole screenful of text and edit it prior to transmission.

The VDU can communicate with the printing terminal at a range of transmission speeds from 10 to 960 characters per second. The speed at which it communicates with the printing terminal can be different from that with which it communicates with the computer under certain conditions.

The facilities provided on the VDU will help with the preparation of punched paper tapes as data can be prepared

a line at a time, checked and corrected, then punched.

This particular VDU (as opposed to other types) was purchased for three main reasons, i.e.;

- Anderson Jacobson guaranteed it would work with out existing terminal equipment (it does) and;
- The line length of the VDU could be made to match the line length of the printers; so an effective line length of 132 or 156 characters could be displayed or keyed onto the VDU and;
- It had an identical main keyboard to that on the printer terminal.

The current cost of the VDU is £1295 plus £150 for the graphics and APL facilities.

The VDU, printer and paper tape unit fit together as shown in Fig 3. Because it is occasionally necessary to bypass one of these units, and to overcome the problem of users changing 25 pin plugs, a simple manual switch was devised which had three functions. It could:

- (i) Bypass the VDU and/or (S1)
 - (ii) Bypass the Paper Tape Unit and (S2)
 - (iii) Switch the terminal system to either (S3)
- the Post Office modem or an acoustic coupler

The layout is shown in the Photograph (Fig 4).

During operation, both the VDU and printer keyboard can be live at the same time, so the user can use whichever one is most convenient for the job in hand.

(b) Extra Buffer Memory

Under certain conditions, usually in plotting, the buffer memory in the printing terminal can overflow. This is currently overcome by storing the plot on punched paper tape, and stopping and starting the tape during reproduction of the plot to allow the buffer to empty. It is now possible to increase the size of the AJ 832 buffer, and it is proposed to do this to overcome this problem more effectively.

(c) Floppy Disc Unit

Consideration is being given to adding a Floppy Disc Unit to the terminal. No final decision has been taken at the time of writing, but this could provide a more convenient means of storing and preparing large quantities of data off line. It can also work with the VDU at 120 characters per second, and would offer a way of experimenting with a 120 characters per second (1200 baud) service later on (see (d) below).

(d) 120 characters per second service (120 baud).

Some services now offer a 120 characters per second facility for received data but only 7.5 characters per second facility for sent data.

The restriction is one imposed by the Post Office.

This facility will not enable many of the techniques discussed in this paper to be used, as they rely on transmission of prepared data at 30 characters per second.

I am therefore waiting for the introduction of a full duplex 1200 baud service. This is currently available in America and should eventually be available on IPSS. When

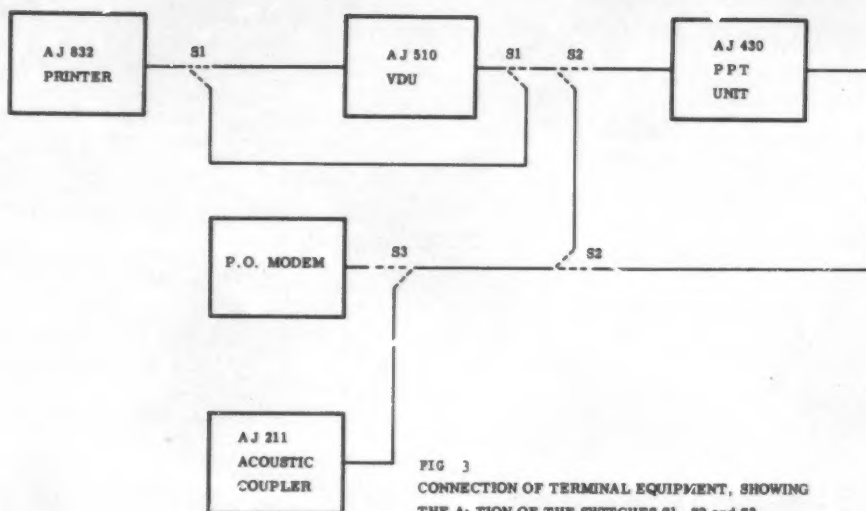


FIG 3
CONNECTION OF TERMINAL EQUIPMENT, SHOWING
THE ACTION OF THE SWITCHES S1, S2 and S3.



it is available, I should be able to experiment with it, having obtained a suitable modem, using the VDU and Floppy Disc Unit and a compatible 120 characters per second matrix printer, currently being used on other projects.

8 CONCLUSION

Many of you listening to me, or reading this paper may well be asking the question - is it really all worthwhile? What have the Laboratory staff gained from this work? How much specialist time has it taken?

The Kodak Research Laboratory does have a small section consisting of scientists trained and working in scientific computing. This section has to cover the computing needs of the whole laboratory. Most of the work described in this paper has been done by myself as a part of my overall job and has never been full time. Over the two and a quarter years of terminal operation, I have spent about three to four man months on this work. That includes selection and installation of equipment and services, writing of instructions and training of users, but does not include the time spent by users of the terminal.

Since starting the system, nearly 1200 Terminal Use Forms have been completed, while the utilization of the terminal has risen, as shown in Fig 1.

The benefits of on line searching to Research scientists do not need repeating here but they are very real and substantial. The benefits of interactive computing as a Research Tool are being more widely accepted in the Laboratory as is shown by the rise in utilization of the terminal for computing. These benefits would not have been possible without the additional facilities, particularly punched paper tape and plotting, which were provided.

Another key factor in the success of the terminal has been the very small amount of time the terminal has been out of action. This is due in part to the quality of the hardware and in part to the speedy maintenance service provided by the suppliers. We may be fortunate in the location of the laboratory relative to the location of Anderson Jacobson's engineers but that was one of the factors taken into account when deciding on this equipment.

When the additional services are available I expect terminal utilization to increase and consideration will have to be given on how to best satisfy this increased demand. The work does not stand still. It is ongoing and in a Research environment, that is perhaps the greatest vindication of the work that has been done in the past.